

What is claimed is:

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1. A protection switching method for a passive  
2 optical network system including  
3 an optical line terminal for switching between  
4 a first active-system transmission/reception section and  
5 a first standby-system transmission/reception section by  
6 using a switch,  
7 a plurality of network unit for selectively  
8 connecting second active-system transmission/reception  
9 sections and second standby-system  
10 transmission/reception sections to subscriber terminals  
11 upon switching said sections through selectors in the  
12 event of a communication abnormality, and  
13 transmission paths for star-connecting said  
14 second active-system transmission/reception sections to  
15 said first active-system transmission/reception section,  
16 and also star-connecting said second standby-system  
17 transmission/reception sections to said first  
18 standby-system transmission/reception section,  
19 characterized by comprising the steps of:  
20 detecting a communication abnormality in at  
21 least one active-system virtual path established between  
22 said optical line terminal and said subscriber terminal  
23 through said transmission path and said network unit;  
24 and  
25 upon detection of a communication abnormality

26 in the active-system virtual path, causing said switch  
27 to switch the transmission paths to establish a  
28 standby-system virtual path between said optical line  
29 terminal and said subscriber terminal serving as a  
30 communication partner.

2. A method according to claim 1, wherein  
2 the method further comprises the step of  
3 simultaneously transmitting warning signals indicating  
4 communication abnormalities from said network units, and  
5 the step of establishing comprises the step of  
6 simultaneously switching a plurality of active-system  
7 virtual paths between said optical line terminal and  
8 said subscriber terminals to a plurality of  
9 standby-system virtual paths by simultaneously  
10 switching/controlling all ports of said switch in said  
11 optical line terminal upon reception of the warning  
12 signals.

3. A method according to claim 1, wherein  
2 the method further comprises the step of  
3 simultaneously transmitting warning signals indicating  
4 communication abnormalities from said network units  
5 which have accessed signals distributed from said  
6 optical line terminal, and  
7 the step of establishing comprises the step of  
8 simultaneously switching a plurality of active-system

9 virtual paths between said optical line terminal and  
10 said subscriber terminals to a plurality of  
11 standby-system virtual paths by simultaneously  
12 switching/controlling predetermined ports of said switch  
13 in said optical line terminal upon reception of the  
14 warning signals.

4. A method according to claim 1, further  
2 comprising the steps of:  
3 transmitting a selector switching signal from  
4 said optical line terminal to said network unit when a  
5 communication abnormality in the active-system virtual  
6 path is detected; and  
7 selectively switching said active-system  
8 transmission/reception section and said standby-system  
9 transmission/reception section in said network unit when  
10 the selector switching signal is received.

5. A method according to claim 1, further  
2 comprising the step of setting an active-system virtual  
3 path and a standby-system virtual path between said  
4 optical line terminal and said subscriber terminal in  
5 different bands.

6. A method according to claim 1, wherein  
2 the method further comprises the step of  
3 setting, in different bands, a plurality of first

4 active-system virtual paths running through said first  
5 and second active-system transmission/reception sections,  
6 a plurality of second active-system virtual paths  
7 running through said first and second standby-system  
8 transmission/reception sections, first standby-system  
9 virtual paths running through said first and second  
10 active-system transmission/reception sections, and  
11 second standby-system virtual paths running through said  
12 first and second standby-system transmission/reception  
13 sections, and  
14 the step of establishing comprises the step of  
15 switching the virtual path to one of the first and  
16 second standby-system virtual paths through said switch  
17 when a communication abnormality is detected in one of  
18 the first and second active-system virtual paths.

7. A method according to claim 6, further comprising the step of resetting the second active-system virtual path and the second standby-system virtual path to share a band assigned to said first active-system transmission/reception section when communication abnormalities are detected in all said first active-system virtual paths.

8. A method according to claim 6, further  
2 comprising the step of resetting the first active-system  
3 virtual path and the first standby-system virtual path

4 to share a band assigned to said first active-system  
5 transmission/reception section when communication  
6 abnormalities are detected in all said second  
7 active-system virtual paths.

9. A method according to claim 1, wherein  
2 the method further comprises the step of  
3 setting a plurality of active-system virtual paths in  
4 different bands, and  
5 the step of establishing comprises the step of,  
6 when a communication abnormality occurs in one of the  
7 active-system virtual paths, limiting a band set for the  
8 remaining normal active-system virtual paths and using a  
9 surplus band as a standby-system virtual path.

10. A method according to claim 1, wherein  
2 the method further comprises the step of  
3 setting a plurality of active-system virtual paths and a  
4 plurality of standby-system virtual paths, and  
5 the step of establishing further comprises the  
6 step of switching active-system virtual paths, except  
7 for an active-system virtual path assigned to a specific  
8 subscriber terminal for which no protection is required,  
9 to standby-system virtual paths, except for a  
10 standby-system virtual path assigned to said specific  
11 subscriber terminal, in the even of communication  
12 abnormalities in the active-system virtual paths except

13 for the active-system virtual path assigned to said  
14 specific subscriber terminal.

11. A method according to claim 1, wherein  
the method further comprises the steps of:  
setting a plurality of active-system virtual  
paths between said subscriber terminal and a plurality  
of first transmission/reception means corresponding to  
said active-system transmission/reception section; and  
setting a standby-system virtual path between  
said subscriber terminal and second  
transmission/reception means corresponding to said  
standby-system transmission/reception section, and  
the step of establishing comprises the step of,  
when an abnormality is detected in an active-system  
virtual path, switching the active-system virtual path  
in which the abnormality is detected to a standby-system  
virtual path by using a band held by said second  
transmission/reception means.

12. A protection switching apparatus for a PON  
2 system characterized by comprising:  
3 an optical line terminal having a first  
4 active-system transmission/reception section and a first  
5 standby-system transmission/reception section for  
6 transmitting/receiving signals and detecting  
7 communication abnormalities in transmission paths;

8 a plurality of network units each having a  
9 second active-system transmission/reception section and  
10 a second standby-system transmission/reception section  
11 respectively connected to said first active-system  
12 transmission/reception section and said standby-system  
13 transmission/reception section through the transmission  
14 paths, said network units being star-connected to said  
15 optical line terminal through the transmission paths;  
16 selectors which are respectively arranged in  
17 said network units to select said second active-system  
18 transmission/reception section and said second  
19 standby-system transmission/reception section connected  
20 to normal transmission paths, one of said selected  
21 second active-system transmission/reception section and  
22 said selected second standby-system  
23 transmission/reception section being connected to  
24 subscriber terminals;  
25 a switch which is arranged in said optical  
26 line terminal to establish a virtual path between said  
27 optical line terminal and said network unit by switching  
28 and connecting the transmission path between said first  
29 active-system transmission/reception section and said  
30 first standby-system transmission/reception; and  
31 a first control section which is arranged in  
32 said optical line terminal to control said switch, upon  
33 detection of a communication abnormality in the  
34 transmission path, so as to switch the abnormal

35 transmission path to a normal transmission path, thereby  
36 reestablishing a virtual path to said subscriber  
37 terminal in which the communication abnormality has  
38 occurred, the virtual path being constituted by an  
39 active-system virtual path and a standby-system virtual  
40 path.

13. An apparatus according to claim 12, wherein  
2 the transmission path is formed from a metal line.

14. An apparatus according to claim 12, wherein  
2 the transmission path is formed from a coaxial cable.

15. An apparatus according to claim 12, wherein  
2 the transmission path is an optical  
3 transmission path, and  
4 said network unit is an optical network unit.

16. An apparatus according to claim 15, wherein  
2 the optical transmission paths respectively star-connect  
3 said second active-system transmission/reception section  
4 and said second standby-system transmission/reception  
5 section to said first active-system  
6 transmission/reception section and said first  
7 standby-system transmission/reception section through  
8 photocouplers.



17. An apparatus according to claim 12, wherein said switch outputs an ATM cell to one of a plurality of ports, to which said first active-system transmission/reception section and said first standby-system transmission/reception section are connected, in accordance with a header value added to the ATM cell.

18. An apparatus according to claim 12, wherein said switch determines an output port for data in a synchronous transfer mode in accordance with a time slot of a frame.

19. An apparatus according to claim 12, wherein  
said network units transmit warning signals  
indicating communication abnormalities in the  
transmission paths, and

5           said first control section switches/controls  
6 all ports of said switch to simultaneously switch  
7 virtual paths between said optical line terminal and  
8 said subscriber terminals from active-system virtual  
9 paths to standby-system virtual paths upon  
10 simultaneously receiving the warning signals from said  
11 network units.

20. An apparatus according to claim 12, wherein  
said network units which have accessed signals

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3 distributed from said optical line terminal transmit  
4 warning signals indicating communication abnormalities  
5 in the transmission paths, and  
6 said first control section switches/controls  
7 predetermined ports of said switch to simultaneously  
8 switch virtual paths between said optical line terminal  
9 and said subscriber terminals from active-system virtual  
10 paths to standby-system virtual paths upon  
11 simultaneously receiving the warning signals from said  
12 network units.

21. An apparatus according to claim 12, wherein  
2 said first control section transmits a  
3 selector switching signal to said network unit when a  
4 communication abnormality is detected in the  
5 transmission path, and  
6 said network unit comprises (a) <sup>plurality</sup> second control }  
7 section for controlling said selector to selectively }  
8 switch said second active-system transmission/reception }  
9 section and said second standby-system }  
10 transmission/reception section upon reception of the }  
11 selector switching signal from said optical line }  
12 terminal. }

22. An apparatus according to claim 12, wherein  
2 the active-system virtual path and the standby-system  
3 virtual path between said optical line terminal and said

4 subscriber terminal are set in different bands.

23. An apparatus according to claim 12, wherein  
2 the virtual path comprises a plurality of first  
3 active-system virtual paths running through said first  
4 and second transmission/reception sections, a plurality  
5 of second active-system virtual paths running through  
6 said first and second standby-system  
7 transmission/reception sections, a first standby-system  
8 virtual path running through said first and second  
9 active-system transmission/reception sections, and a  
10 second standby-system virtual path running through said  
11 first and second standby-system transmission/reception  
12 sections, the first and second active-system virtual  
13 paths and the first and second standby-system virtual  
14 paths being set in different bands, and

15 said first control section controls said  
16 switch to switch the virtual path to one of the first  
17 and second standby-system virtual paths when a  
18 communication abnormality is detected in one of the  
19 first and second active-system virtual paths.

24. An apparatus according to claim 23, wherein  
2 when communication abnormalities are detected in all the  
3 first active-system virtual paths, a second  
4 active-system virtual path and a second standby-system  
5 virtual path are reset to share a band assigned to said

6 first standby-system transmission/reception section.

25. An apparatus according to claim 23, wherein  
2 when communication abnormalities are detected in all the  
3 second active-system virtual paths, a first  
4 active-system virtual path and a first standby-system  
5 virtual path are reset to share a band assigned to said  
6 first active-system transmission/reception section.

26. An apparatus according to claim 12, wherein  
2 a plurality of active-system virtual paths are  
3 set in different bands, and  
4 when a communication abnormality is detected  
5 in an active-system virtual path, a band set for  
6 remaining normal active-system virtual paths is limited,  
7 and a surplus band is used as a standby-system virtual  
8 path.

27. An apparatus according to claim 12, wherein  
2 a plurality of active-system virtual paths and  
3 a plurality of standby-system virtual paths are set, and  
4 said first control section controls said  
5 switch, in the event of communication abnormalities in  
6 active-system virtual paths except for an active-system  
7 virtual path assigned to a specific subscriber terminal  
8 for which no protection is required, so as to switch the  
9 active-system virtual paths in which the communication

10 abnormalities have occurred to standby-system virtual  
11 paths except for a standby-system virtual path assigned  
12 to said specific subscriber terminal.

28. An apparatus according to claim 12, wherein  
2 a plurality of active-system virtual paths are  
3 set between said subscriber terminals and a plurality of  
4 first transmission/reception means corresponding to said  
5 active-system transmission/reception sections,  
6 a standby-system virtual path forming a  
7 virtual path is set between said subscriber terminal and  
8 second transmission/reception means corresponding to  
9 said standby-system transmission/reception section, and  
10 when an abnormality is detected in an  
11 active-system virtual path, the active-system virtual  
12 path in which the abnormality has been detected is  
13 switched to a standby-system virtual path by using a  
14 band held by said second transmission/reception means.

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